

The Feeding and Reproductive Behaviour of the Sacoglossan Gastropod *Olea hansineensis* Agersborg, 1923

BY

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INTRODUCTION

SACOGLOSSANS ARE AN ORDER of opisthobranchs which typically have an herbivorous mode of feeding (HYMAN, 1967). The family Oleidae has a single member, *Olea hansineensis* Agersborg, 1923, which has previously been recorded only on Brown Island in the vicinity of Friday Harbor, Washington (Figures 1, 2). The original report by AGERSBORG (1923) comprises the only published knowledge of this unique sacoglossan.

The present study was done in the laboratory at Friday Harbor, and is the result of two months examination of approximately 40 specimens of various sizes which were collected for me by Dr. Thomas E. Thompson and Mr. Gordon Robilliard.

HABITAT

The specimens used in this study were collected intertidally and subtidally to 40 feet from Jaekle's Lagoon and Garrison Bay on San Juan Island, and Parks Bay, Shaw Island. This extends the range of *Olea* only slightly from its original source at Brown Island. In all cases *Olea* is found in shallow embayments with mud bottoms, either upon, inside, or near the egg masses of the cephalaspidean opisthobranchs *Haminoea virescens* (Sowerby, 1833), *Ag-laja diomedea* (Bergh, 1894), or *Gastropterion pacificum* Bergh, 1893.

FOOD SOURCES

Olea hansineensis was reported by Agersborg to possess neither a single toothed radula nor an ascus. I confirmed

by serial sectioning and by dissection the absence in *Olea* of these two diagnostic sacoglossan characters. *Olea* thus cannot feed in the typical sacoglossan manner, in which the single toothed radula is used to slit open cells of algae (GONOR, 1961). Instead, *Olea* has become the only known carnivore among the Sacoglossa.

In the field I have observed *Olea* eating the eggs of *Haminoea virescens*, *Ag-laja diomedea* and *Gastropterion pacificum*. In the laboratory they showed a wider range of diet, and would also eat eggs of nudibranchs as diverse as *Archidoris montereyensis* (Cooper, 1862), *Hermisenda crassicornis* (Eschscholtz, 1831), and *Dendronotus iris* Cooper, 1863. The only food source I found *Olea* utilizing was the eggs of other opisthobranchs.

When recently fed specimens are sectioned or dissected, the midgut, particularly its branches into the cerata, is seen to contain veligers, giving the impression of a unique system for brooding eggs in the digestive tract (Figure 3). This illusion results from the fact that *Olea* is capable of eating eggs in any developmental stage, even completely shelled veligers just prior to hatching. These are not digested in the stomach region, but are passed immediately to the midgut.

AGERSBORG (1923) observed *Olea* floating upside down at the water surface and concluded they were eating microscopic organisms. Although I observed suspended animals for many hours in the laboratory, I rarely saw any movement of the mouth parts. Instead, the animals floated with the current, their heads bent down into the water and swinging back and forth. Considering the availability of high energy eggs which *Olea* is adapted to feed upon, it is unlikely that these movements are a form of feeding, but rather serve as a means of searching for food. Animals in aquaria were observed to move more than a meter to a new food source by this method.

FEEDING BEHAVIOUR

Animals placed in a dish containing opisthobranch eggs travel randomly, moving the head constantly from side to side. Contact with egg masses appears to be accidental, although short distance chemoreception may occur. Once contact with the egg mass is made by the dorsal and ventral labial lobes, the animal moves onto the egg mass. If feeding is to take place, the animal pushes head first into the mass. Usually the entire animal enters, although at times only the head and neck are inserted. Cilia, covering its entire body, provide excellent propulsion in the viscous jelly which binds the eggs together. While *Olea* moves through the jelly between the strings of eggs, the labial lobes are constantly moving, pushing the jelly apart to allow the head and rest of the body to follow. *Olea* is very plastic, and flattens and twists its body to conform to the opening offered.

When feeding, *Olea* consumes large quantities of eggs, as many as 15 to 20 a minute. The neck and head region are enlarged and curve downwards with the mouth opening into a large circular orifice. The muscular pharynx exerts a pumping action which can be detected in the slight back and forth movement of the animal when it is not completely inside an egg mass, and also in movement of the individual eggs which are pulled against the fertilization membrane several times before being pulled free. If the eggs are in the early stages of development they are sucked in along with the fertilization membrane. If eggs are in later stages, the egg membrane is usually broken by the suction and only the veliger is ingested, leaving behind an empty egg case with a slit down one side. The pumping action appears to continue constantly during feeding, but only when the oral lobes of *Olea* are applied directly to the egg case itself is the mechanism effective.

Olea tends to follow along a string of eggs, engulfing each one until, by swinging the head, it begins on another row. More than a dozen individuals, ranging from 1 to 7 mm in length, have been observed living inside one 18 mm long *Aglaja diomedea* egg mass. *Olea* remains in an egg mass until all the eggs have either been eaten or have hatched.

Feeding is infrequent; the animal feeds only a few times a day, usually for less than an hour each time. At other times, *Olea* either exhibits reproductive behaviour, or enters an immobile resting state. While resting, most of the epidermal pigment is contracted, giving a pale cream color to the animal which blends with the egg mass. This corresponds to the "death feigning" observed by AGERSBORG (1923). I interpreted this behaviour as a resting state because it occurs most frequently when *Olea* has finished eating and is inside an egg mass, probably digesting its most recent meal.

REPRODUCTIVE BEHAVIOUR
AND DEVELOPMENT

Olea is gregarious and forms "courtship groups" from the time it is about 2 mm in length. Reproduction commences at approximately 4 mm. Courtship groups occur when one animal trails another until it pushes the body of the first with its oral lobes. Both animals then stop and spend some time nudging each other. At times they may pause, either lying side by side, or head to tail in the copulatory position. In this position mating is reciprocal, the penis of one being inserted in the female atrium of the other. Any animal moving nearby will join the pair and large groups may form. Grouping takes place on the sides of the container or the surface of an egg mass, and groups may remain together for an entire day.

Animals oviposit the next day, the egg ribbon being laid in a counterclockwise coil of $1\frac{1}{2}$ to 4 turns, with 250 to 600 eggs per ribbon, arranged in a close spiral thread inside the jelly. The egg masses were laid on the sides of the container, as well as on the surface of *Aglaja* or *Haminoea* egg masses. Eggs were also observed inside the egg masses of *Aglaja* where they formed a thin thread in the jelly between the *Aglaja* egg cases. They appeared to develop normally in this situation, and although adult *Olea* often ate every egg in the *Aglaja* egg mass, the ribbon of *Olea* eggs remained completely untouched. Indeed, adults were observed to recoil violently from their own egg mass by contracting and changing direction. Apparently, contact is necessary for recognition of their egg masses.

Eggs follow the typical spiral cleavage and development of a Type I veliger (THOMPSON, 1961). Hatching occurred on the sixth day. Veligers lived for only one week before dying. Metamorphosis would not take place although fresh *Aglaja* eggs were used as substrate. Recently settled individuals found in the field were measured for initial growth rates. Ten individuals with a mean length of 1.65 mm grew to 3.75 mm in 9 days, and were spawning by the twelfth day.

The fast development of eggs and growth of young suggests that *Olea* has several generations in a season. This coincides with the hypothesis of MILLER (1962) that opisthobranchs feeding upon a seasonal food supply have a large, rapidly reproducing population when the food is available, and only a few overwintering individuals. These individuals presumably exist on the remnants of the normal food supply or vary their diet to include the eggs of overwintering reproducers.



Figure 1

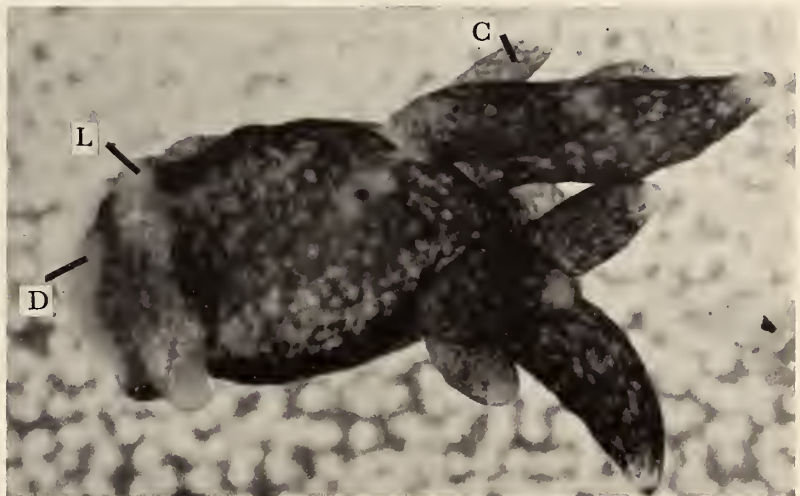


Figure 2

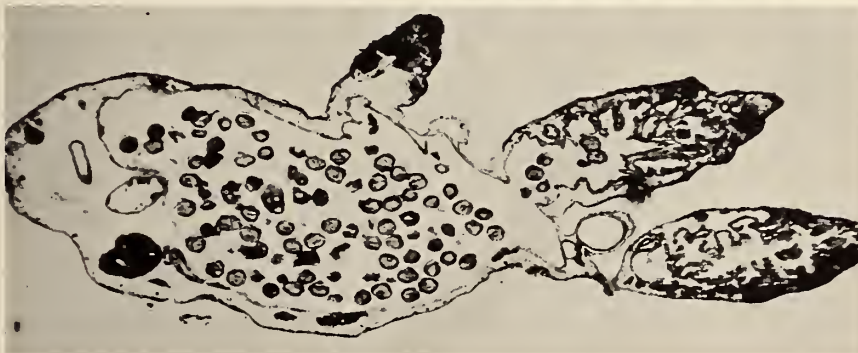


Figure 3

Figure 1: Lateral view of *Olea hansineensis* moving along the surface of an *Archidoris montereyensis* egg mass. The animal is 7 mm long.

Figure 2: Dorsal view of *Olea hansineensis* emerging from an egg mass showing lateral labial lobes (L), dorsal labial lobe (D) and cerata (C).

Figure 3: Lateral section of *Olea hansineensis* revealing the well developed eggs of *Gastropteron pacificum* in the midgut and its branches into the cerata. Contracting during preparation for sectioning forced most veligers out of the cerata.